ARTICLE XIV.

ON SPECIES OF FOSSIL PLANTS FROM THE TERTIARY OF THE STATE OF MISSISSIPPI.

BY LEO LESQUEREUX.

With Ten Plates.

The specimens of fossil plants described and figured in this memoir were collected and sent to me for examination, a few years ago, by Prof. Eug. W. Hilgard, State Geologist of Mississippi. A short account of these plants has been already published in the first volume of his Report.* The examination was then commenced, and has been interrupted and put aside until now, by unforeseen circumstances.

These remains of leaves are mostly preserved in a kind of hard, red, ferruginous, more or less laminated shale. A few of them are imbedded in a soft whitish clay; some others in a darker yellowish coarser clay, and one species in a coarse brown sandstone. As the geological and geographical distribution of the deposits where these plants have been found will be examined hereafter, I have merely indicated, after the description of each species, the color of the stone with which it is connected.

1. CALAMOPSIS DANAI, *Lesqx.* Pl. xiv, Fig. 1, 2, 3. C. foliis magnis, frondosis, pinnatis; pinnis gramineis, planis, oppositis, æquidistantibus, basi subattenuatis; nervis primariis 3–5 æqualibus, secundariis unicis, gracilioribus, lineales areas dividentibus, nervulis minimis, parallelibus, approximatis, notatas.

Yellow coarse clay.

A figure of this beautiful palm is given by Prof. Jas. D. Dana in his Manual of Geology, page 513, Fig. 95. The leaflets or pinnæ are somewhat narrowed at the base, as seen in Fig. 2. In Fig. 1, they seem to be slightly decurrent on the rachis, an appearance due to some deformation by the process of petrification. These leaflets are ribbon-like, and it seems, pretty long. Near the base of the frond they are about one inch broad, with five to seven primary nerves, while in the upper part their breadth is but one-fourth of an inch, marked only by three to five primary nerves. The spaces or areas between these nerves are divided in the middle by a secondary vein, less marked than the primary ones,

---

* Report on the Geology and Agriculture of the State of Mississippi, by Eug. W. Hilgard, Pr. D. (1860), pages 108, 109, &c.

and between these, there are still three to five very fine veinlets, thus forming a tricompound, parallel nervation. The rachis is proportionally narrow, about one-fourth of an inch broad, and is narrowly furrowed in the middle.

The only fossil plant known as being evidently related to this species is *Calamopsis Bredana*, Heer, Flor. Helvet. Tert. III, p. 169, Pl. cxlix, from Œningen. It differs essentially from the American plant by its nervation, which is only a compound of two kinds of veins, and by its narrow leaflets, which are placed somewhat in pairs. The European species has, like ours, the ribbon-like leaflets narrowed at the base, appearing also, from the figures, sometimes slightly decurrent.

This plant is referable to the Palm family; but no living species is known, which can be compared to it.

2. SABAL GRAYANA, *Spec. nov.* Pl. xiv, Fig. 4, 5, 6. S. fronde petiolata, rachide in plano posteriore subplana, e basi dilatata ovata, lineari cuspidata 6–8 policari; foliis flabelliformibus, radiis numerosis, elongatis, sensim dilatatis, nervulis distantibus, gracilimis.

Soft white clay.

The specimens figured indicate the form of a whole leaf. The rachis contracted just at its base, is abruptly enlarged above and then tapers upwards into a long linear point. The rays, about one-eighth of an inch broad near their point of union to the rachis, gradually enlarge upwards. Fig. 6 shows them to be already one inch; on some broken pieces of specimens they are two inches broad. Though the nervation is distinct, the veinlets are not strongly marked, and they are rather at a distance from each other, their number varying from five to ten, according to the breadth of the rays. This greater distance of the thinner veinlets, the peculiar contraction of the base of the rachis, and the broader rays, are the only appreciable characters which separate this species from *Sabal major*, Heer, a fossil plant whose remains are abundant in the Miocene of Europe. Small fragments of a species indescribable, but evidently different from this one, have been collected at Nanaimo, Vancouver's Island, by Dr. John Evans.

3. SALISBURIA BINERVATA, *Spec. nov.* Pl. xv, Fig. 3 to 6. S. foliis subquadratis, polymorphis, e basi rotundata abrupte attenuatis, superne dilatatis, truncatis, lobatis vel lacerato-divisis, margine undulatis; nervis primariis binis, angulo vario e basi divergentibus, secundariis e primariis sub angulo acuto egredientibus, dichotomis.

Red shale.

It is not easy to get an idea of the true form of this species from the mere fragments which have been found. Evidently these leaves were polymorphous, as they are now in the living species of *Salisburia*. They were apparently about square, with a round decurrent base, the sides undulate and the upper part truncate and cut in irregular divisions. The nervation of these leaves is peculiar. Two distinct primary nerves diverge from the

base, and the secondary nerves come out of them and fork in ascending, being generally straight in the middle part of the leaves, and arched on both sides, a nervation somewhat similar to that of some *Cyclopteris* of the coal measures. In *Salisburia adiantifolia*, Smith, from Japan, the only living species with which I am acquainted, the primary nerve appears as if split in two branches, which form the two margins of the leaves, and from which the secondary nerves ascend in forking. Another fossil species of *Salisburia* has been collected by Dr. J. Evans at Nanaimo, Vancouver's Island, in fragments too incomplete for a satisfactory comparison. None have been described from the Tertiary of Europe. There is one known from the Pliocene of Italy.

4. POPULUS MONODON, *Spec. nov.* Pl. xv, Fig. 1 and 2. P. foliis longis, latisque, lamina sexpolicari et ultra, deltoideo acuminatis, margine undulatis, vel parce irregulariter obtuse lobatis, nervo medio crasso, nervis lateralibus apertis, arcuatis.

Red shale.

This plant is represented only by the two specimens here figured; and as the base of the leaves is not preserved, the essential character, viz., the basilar nervation, cannot be taken into account. The large ovate or deltoid lanceolate acuminate leaves are probably rounded or cordate at the base, and have the borders either entire or undulate, or marked with a single obtuse lobe. The medial nerve is pretty thick, and the secondary ones are joined to it in an open angle and arched.

By its nervation and the size of the undulate scarcely lobed leaves, this species is closely related to *Populus Gaudini*, Heer, whose leaves are also entire or marked with a few round teeth. The European species differs only by its proportionably narrower and longer acuminate leaves.

5. POPULUS MUTABILIS, VAR. REPANDO-CRENATA, *Heer.* Pl. xviii, Fig. 4, 5, 6. P. foliis longe petiolatis, ovato ellipticis, lanceolatis, basi cuneato attenuatis, margine repando crenatis, nervo medio crasso, nervis lateralibus sub-curvatis.

Red shale.

Though the whole form of the leaves cannot be seen from the fragments found and figured, all the appreciable characters refer these fossil leaves to the species described by Prof. Heer, Flor. Tert. Helv., II, page 22, Pl. lxi, Fig. 12, 13, 14, and Pl. lxii, as one of the varieties of his *Populus mutabilis.* The broad medial nerve, the long petiole, the crenate-lobed borders of the leaves, and the disposition of the secondary nerves are alike. Both leaves represented in our Fig. 4 are obscure. The long petiole is flattened and the secondary veins are indistinct, or rather look as if they had been split by maceration. As much as can be seen from the fragments, the leaves were of large size, ovate-lanceolate,

wedge-form at the base or narrowed to the long thick petiole, and wavy crenate on the borders.

6. SALIX WORTHENII, *Spec. nov.* Pl. xv, Fig. 7. S. foliis in petiolum sensim attenuatis, exacte lanceolatis acutis, margine integerrimis, nervo medio angusto, nervis secundariis gracilibus, numerosis, sub angulo latiore exeuntibus, valde curvatis, alternatim brevioribus, camptodromis.

Soft white clay. La Grange, Tennessee; Mound City, Illinois.

The leaf here figured under the above name was communicated to me by Prof. A. H. Worthen, State Geologist of Illinois. A second, with the same shape and the same nervation, only smaller, was sent by Prof. James Safford, from La Grange, Tennessee.

The leaves of this willow are exactly lance-shaped, equally narrowed toward the point, and the petiole proportionably broad and short. The nervation is distinct, though the secondary nerves are thin. These come out of the medial nerve in an open angle and, from the middle, curve strongly upwards along the borders. Alternately shorter and longer, the shorter ones divide by veinlets, and anastomosing with branches of the long ones, they form a reticulation of pretty large square or polygonous areas.

I do not know of any living species which this one resembles. Its nearest relatives among fossil plants are, for the form of the leaves, *Salix integra*, Gopp., and for the nervation, *Salix tenera*, Al. Braun, both from Œningen. Indeed, it should be considered as identical with this last species, if, according to Prof. Heer's remarks, its leaves are sometimes taper-pointed and narrowed, not only toward the point but toward the base. Fig. 10, Pl. lxviii, of Heer's Flor. Tert. Helvet., approaches this form, but our leaves are proportionably shorter and still more exactly lanceolate.

7. SALIX TABELLARIS, *Spec. nov.* Pl. xvii, Fig. 4. S. foliis elongatis, ultra pollicaribus latis, linearibus, margine parallelis, integerrimis, in petiolum attenuatis; nervo medio lato, nervis secundariis numerosis, irregularibus, angustis, camptodromis.

Soft white clay.

The leaf appears short petioled. From the width of the medial nerve, and from its gradual decrease up to the broken point, the blade of the leaf is at least twice as long as the preserved part of the specimen. The borders are exactly parallel and entire; the surface smooth, apparently shining. The secondary nerves are irregular, generally long ones, curving along the margins, alternating with short ones, or sometimes coming out of the medial nerve in various angles of divergence.

Except that the leaves are broader and the borders exactly parallel, our species would appear identical with *Salix longa*, Al. Braun, from Œningen. As *Salix angusta*, Al. Braun, also from Œningen, may be, according to Prof. Heer, a mere variety of *Salix longa*, though its leaves are narrower, our species might be as well considered as a variety with

broader leaves of the same species. The three forms here considered have as common characters the peculiar great length of the leaves, the entire margins, the broad medial nerve, and thick petiole.

8. QUERCUS MOORII, *Spec. nov.* Pl. xvi, Fig. 1, 2, 3. Q. foliis coriaceis, oblanceolatis, vel obovatis oblongis, elongatis, subobtusis, margine remote, breviter serratis; nervis secundariis, sub angulo latiore egredientibus, curvatis, craspedodromis.

Red shale.

The peculiar nervation of this beautiful species of oak shows the identity of the three specimens here figured. The secondary nerves, emerging from the medial one in an open angle (50 to 65°), curve upwards, and preserving about the same thickness in their whole length, abruptly bend backwards near the margin in entering the teeth. These secondary nerves are mainly opposite near the base, but become alternate and more distant in the upper part of the leaves. Judging from this appearance, and also from the scarcely decreased thickness of the medial nerve, the preserved part of the large leaf, Fig. 1, is not more than one-half of its whole length. Another specimen of the same species, which has not been figured, on account of obliteration of its borders, measures, from the top to near the base of the petiole, six inches, and is two and one-half inches broad. In the same proportion, the large leaf, which is four and one-half inches broad, would be nearly one foot long. These dimensions, compared with those of some oak leaves of our time, with the leaves of *Quercus macrocarpa*, Mich., for instance, are not extraordinary. This oak is related also to our fossil species by its nervation and the general outline of its oblanceolate leaves.

I do not know any other living species to which this fossil oak might be compared, except, perhaps, to *Quercus densiflora*, Hook, from California. It is named for Rev. W. D. Moore, a voluntary and most valuable coadjutor of Prof. Hilgard in his survey.

9. QUERCUS LYELLII, *Heer.* Pl. xvii, Figs. 1, 2, 3. Q. foliis subcoriaceis, lanceolatis, acutis vel brevi acuminatis, basi in petiolo brevi attenuatis, margine integris, undulatis, nervo medio recto, nervis secundariis apertis, curvatis, ramulo superiore margine approximato.

Red shale.

No difference is perceivable between the figures given by Prof. Heer of this species, in his Fossil Flora of Bovey Tracey, Pl. lxiii, Fig. 2 to 9, and ours. The general outline of the leaves, their margins entire or wavy, the direction and branching of the secondary nerves, the reticulation also, all is similar. In the three broken specimens here figured, the three essential forms indicated by the author of this species are even recognized: Narrow lanceolate leaves tapering toward the base, with slightly undulate borders as in Fig. 1; longer, proportionately narrower leaves, with nearly parallel sides, as in Fig. 3;

broader more distinctly undulate leaves, with a more abruptly narrowed base, as in Fig. 2. The primary nerve is of medium thickness; the angle of divergence of the secondary ones is about 50°. In our specimens the secondary nerves are generally opposite from the base of the leaves up to the middle, a character marked also in Heer's Fig. 6. They nearly reach to the borders, where they fork, the upper branches running along the borders and uniting to the next. The areas are divided into secondary ones by continuous, sometimes forking veinlets, forming a kind of irregularly polygonal reticulation, which still incloses a more delicate subquadrate one. Prof. Heer points out the relation of this fossil oak to some species now living in Mexico: *Quercus Xalapensis*, Thunb., *Q. undulata*, Web. This type has many representatives in the Miocene of Europe.

10. Quercus retracta, *Spec. nov.* Pl. xvi, Figs. 4, 5. Q. foliis coriaceis, politis, obovatis, oblongis, vel lineari lanceolatis, integerrimis; nervo premario plano, recto; secundariis tenuibus, horizontalibus vel retro curvatis, camptodromis imperfectis, arcis abreviatis.

Red shale.

I have figured the only fragments, though small, found of this species. By the form of the leaves, evidently very variable, and by its peculiar nervation, it has a marked relation to our living *Quercus aquatica*, Catesb., of the Southern States. With generally obovate or oblong lobed leaves, this oak has also narrow linear entire leaves, whose nervation is scarcely different from that of the fossil species as marked Fig. 4 a. *Quercus elœna*, Heer, of the Œningen stage of the Tertiary of Europe, is also closely related to the Mississippi species. It may be identical, but our specimens are too incomplete to allow a satisfactory comparison.

11. Quercus Chlorophylla, *Ung.* Pl. xvii, Figs. 5, 6, 7. Q. foliis coriaceis, ovatis, oblongis, obtusis, vel apice rotundatis, quando que sub-emarginatis, integerrimis, margine reflexis, nervis secundariis tenuibus, obsoletis, camptodromis, angulo acuto egredientibus.

Red shale.

As far as can be ascertained in comparing fossil leaves whose nervation is undiscernible, our species is identical with the one described under the above name by Prof. Unger, Chlor. Protog., page 111, Pl. xxxi, Fig. 1. However, it is not certain that these leaves belong to an oak. Oval, thick, entire coriaceous leaves of the same form as ours are found in different genera of living plants. The author compared this species to *Quercus imbricaria*, Mich., *Q. cinerea*, Mich., and *Q. virens*, Ait. But all these species of ours have a well-marked nervation, and their leaves are thinner or less coriaceous.

12. Celtis brevifolia, *Spec. nov.* Pl. xx, Figs. 4 and 5. C. foliis ovatis, acutis, vel acuminatis, brevibus, integerrimis, basi rotundatis, latere uno latiore inæqualibus, nervo medio recto, secundariis distantibus, oppositis, imperfecte acrodromis, nervulis subcontinuis, parallelis.

Red shale.

These leaves are likely acute or short acuminate. Their unequal round base resembles that of leaflets of a compound leaf. But I do not know of any having like form of leaves and such a peculiar nervation. *Celtis Mississippiensis*, Bosc., of our times, most resembles the fossil species. Its leaves are longer, indeed, and proportionally narrower; but especially at the base of the branches, leaves are casually short and broad. The base is unequal and rounded, and the secondary nervation and ultimate reticulation similar to that of our fossil leaves, marked Fig. 5 a.

13. FICUS SCHIMPERI, *Spec. nov.* Pl. xviii, Figs. 1, 2, 3. F. foliis membranaceis, ovato lanceolatis, acuminatis, basi rotundatis vel subtruncatis, integris, undulatis, tri subquinque nerviis, inæqualibus; nervis secundariis camptodromis, nervulis distantibus, continuis.

Red shale.

These fine leaves are the most numerous and best preserved of the specimens from Mississippi. Numerous as they are, nevertheless, no trace of a petiole is seen on any of them, though they were evidently stalked. Their general form is ovate acuminate, with round base, and entire, more or less undulate borders. The two inferior pairs of the secondary nerves are generally not far distant from each other; sometimes, as in the large leaf, Fig. 3, they become nearly connected, and the basilar trinervation becomes a five-compound nervation. This peculiarity, more marked still in other of these fossil leaves, seems to indicate the identity of both *Ficus truncata* and *Ficus Ruminiana*, Heer, to which our species is related. For the essential difference between them is the quinque-nervation of the first and the trinervation of the second. In our species the angle of divergence of the secondary nerves is more acute, the veins and veinlets more deeply marked, these being continuous and forming broader areas, subdivided into an ultimate minute irregularly quadrate reticulation, as in *a*, Fig. 1.

14. FICUS CINNAMOMOIDES, *Spec. nov.* Pl. xvii, Fig. 8. F. foliis late ovatis, basi rotundatis, integerrimis, irregulariter trinerviis; nervo medio arcuato, nervis secundariis crassis, angulo acuto sinu obtuso egredientibus, subtus ramosis.

Soft white clay.

If this leaf, represented by one broken specimen only, is, as it seems, pointed or acuminate, it has some likeness to *Ficus Tiliæfolia*, Heer, as it is figured, Flor. Tert. Helvet., Pl. lxxxiii, Fig. 3. Its nervation presents a kind of anomaly in this: that being unequally tricompound at the base, the secondary nerves branch in the same way as they do in this genus when the basilar nervation is in five. The secondary nerves unite to the arched medial one by a small obtuse sinus. The form of the leaf is about round, with perfectly entire borders.

15. LAURUS PEDATUS, *Spec. nov.* Pl. xix, Fig. 1. L. foliis coriaceis, oblanceolatis, in petiolum longe attenuatis integerrimis; nervo primario latiore, plano, nervis secundariis tenuibus, sub angulo acuto 30° egredientibus, camptodromis, areolatione ultima punctiformi.

Red shale.

This leaf is made up of two fragments. It is apparently short-stalked; its shape is oblanceolate, the entire borders gradually descending to the base and tapering upwards from the middle into a slightly obtuse point. The secondary veins are thin but distinct, nearly as slender as the veinlets, and somewhat flexuous or variously bending to branching points. Among fossil plants, this species is distantly related to *Laurus princeps*, Heer, a species abundant in the Miocene of Europe. The long tapering base of the American fossil is its essential specific character.

16. CINNAMOMUM MISSISSIPPIENSE, *Lesqx.** Pl. xix, Fig. 2. C. foliis subcoriaceis, ovatis, lanceolatis, acuminatis, basi in petiolo brevi, semipollicari longo, subdecurrentibus, integerrimis, triplinerviis, nervis lateralibus ultra ⅔ evanidis.

Brown coarse sandstone.

This species is, like the former, represented by some specimens, which, though separately incomplete, show, taken altogether, the entire form, except the point. It pretty closely resembles *Cinnamomum Buchi*, Heer, Flor. Helvet. Tert. ii, page 90, Pl. xcv, Fig. 1 to 8, whose leaves are variable. Our leaf evidently differs in its more exactly ovate form, being largest below the tapering point, which is accordingly longer than the more abruptly rounded base. In *Cinnamomum Buchi*, on the contrary, the greatest enlargement is above the middle; therefore its leaves are more abruptly narrowed into a point, while they are more gradually narrowed toward the petiole. The reversed figure of *C. Buchi* would be just like that of *C. Mississippiense* in its natural position. From *Cinnamomum Heerii*, Lesqx., Amer. Journ. of Sci. and Arts, § 2, vol. xxvii, p. 361, to which this species is also allied, it differs by the leaf being twice as large, and by the relatively narrower nerves. The junction of the lateral with the medial nerve is not as high up above the base as in the species of Vancouver's Island. It is the only fossil leaf of a *Cinnamomum* obtained from the Atlantic slope.

17. BANKSIA HELVETICA, *Heer.* Pl. xvi, Fig. 6. B. foliis coriaceis, sessilibus, oblanceolatis, obtusis, integerrimis, basi sensim attenuatis, truncatis; nervo medio valido percurrente, nervatione hyphodroma.

Red shale.

The leaf is about two inches long, half an inch in its broadest part, round obtuse above,

* Dana's Manual of Geology, page 513, Fig. 94.

with its lower part slightly decreasing towards the base and abruptly rounded or truncate on both sides of the basilar part of the nerve. By its peculiar form, its percurrent slightly curved medial nerve, and its obscure reticulation, this leaf is referable to Heer's species in Flor. Helv. Tert. ii, page 98, Pl. xcvii, Figs. 44 to 48. It is essentially similar to both specimens of Fig. 44, which show a truncate base, a curved medial nerve, and an obtuse point like ours. In the American leaf the *areolæ* appear smaller and more distant than are figured in European specimens.

18. PERSEA LANCIFOLIA, *Spec. nov.* Pl. xix, Figs. 3 and 4. P. foliis lanceolatis, utrinque attenuatis, acutis, vel acuminatis, integerrimis, nervo medio crasso, nervis secundariis angulo acuto egredientibus, distantibus, curvatis, camptodromis.

Red shale and yellow coarse clay.

A number of specimens have been collected, both on the red shales and the coarse clay, in the same state of preservation as those which I have figured. The form of the point and of the basilar part of these leaves is not known. The details of nervation are obsolete, the medial nerve is remarkably broad, the secondary ones curve upwards from an angle of divergence of about 40°. The lanceolate entire, apparently membranaceous leaves, enlarged in the middle, taper equally to both ends. I do not know of any near relation to this species. It may be compared to *Persea speciosa*, Heer, from the Upper Miocene of Europe.

19. CEANOTHUS MEIGSII, *Spec. nov.* Pl. xix, Figs. 5, 6, 7. C. foliis petiolatis, late ovatis, basi truncatis, cordatisve, in longum apicem attenuatis, obtuse æqualiter serratis, triplinerviis, nervis secundariis infimis basilaribus, tenuibus, superioribus crassis, nervo primario subæqualibus, arcuatis, extrorsum inferne ramosis, acrodromis imperfectis.

Yellow coarse clay, Mississippi; soft white clay, La Grange, Tennessee.

Allied to *Ceanothus Tiliæfolius,* Ung., of the Miocene of Europe, this species also resembles our living *Ceanothus Americanus*, L. The difference is essentially in the long narrow point of the fossil leaves, in their large size, and in the obtuse and more equal teeth which surround them. Both species have in common the general form of the leaves and the nervation. This genus, still represented by many species in our flora, especially in California, has apparently left numerous representatives in the recent formations of our country. There is in Prof. Hilgard's collection a number of specimens of this species, and from eight specimens sent from La Grange, two of them belong to it. I have found also in the chalk-banks of Columbus, Kentucky, another species still more like *Ceanothus Americanus*, L., indeed undistinguishable from it,* with shorter, obtusely pointed, more irregularly serrate leaves.

---

* Journal of Science, § ii, vol. xxvii, p. 365.

The specimen copied, Fig. 7, was collected near La Grange, by Prof. B. Meigs, and communicated by Prof. James Safford, to whom I am indebted for all the specimens from Tennessee.

20. SAPINDUS UNDULATUS, *Al. Braun.* Pl. xxii, Fig. 6. S. foliis membranaceis, lanceolatis, subobtusis, basi attenuatis, inæquilateralibus, subfalcatis, margine undulatis; nervo medio crasso, nervis secundariis sub angulo acuto egredientibus, vix curvatis.

Red shale.

Our leaf is shorter than the figure given of this species by Heer, Flor. Tert. Helv., Pl. cxxi, Fig. 5, but there is no other difference. It is slightly obtuse, inequilateral, falcate; the nearly opposite secondary nearly straight nerves diverge in acute angles from the thick primary one; all characters found alike in both the European and the American leaves.

21. RHAMNUS MARGINATUS, *Lesqx.* Pl. xxii, Figs. 3, 4, 5. Geol. Report of Arkansas, II, page 319, Pl. vi, Fig. 1. R. foliis subcoriaceis, petiolatis, oblongis, ovalibus, acutis vel subobtusis; margine (reflexo?) integris, nervo medio crasso, nervis secundariis angulo acuto egredientibus, secundum marginem decurrentibus, valde curvatis nervulis parallelis.

Red shale.

This marked species is closely related to, if not identical with *Rhamnus Carolinianus*, Walt. The leaves of the fossil plant are broader, more abruptly narrowed to the petiole, and more obtuse at the point; the medial nerve is slightly broader and the petiole is longer. The secondary nerves curve along the borders, closely following them, thus appearing to form a margin all around the leaves. In specimens of *R. Carolinianus*, collected in the mountains of Arkansas, and whose leaves are somewhat thick and shining, the secondary nerves run to and along the reflexed margin in such a way that maceration and compression would, I think, produce the same apparent border as is seen on the fossil leaves. In large leaves also of the Arkansas variety, the medial nerve is as broad, and the petioles are as long as in the fossil species. The best preserved specimens of the collection are here represented. The leaves are very variable in size, and apparently more or less pointed. This species is not intimately related to any fossil one of the tertiary of Europe, where the genus is nevertheless abundantly represented.

22. JUGLANS APPRESSA, *Spec. nov.* Pl. xx, Fig. 6. J. foliis lineari lanceolatis, margine dentibus appressis obscure serratis, nervo medio valido, nervis secundariis ex angulo subrecto valde curvatis, camptodromis, crassioribus.

Red shale.

The reticulation of this fragment of leaf shows it to belong to a *Carya* or a *Juglans*. By comparison with leaves of *Juglans rupestris*, Engl., a species from California, the

nervation, reticulation, and also the obsolete serration, appear much alike. In the Miocene Flora, *Juglans Heerii*, Ett., is its nearest relative. The nervation and reticulation, as figured in Heer's Flor. Tert. Helvet., Pl. xcix, Fig. 236, are similar.

23. JUGLANS SAFFORDIANA, *Spec. nov.* Pl. xx, Fig. 7. J. foliis ovato lanceolatis, acutis, basi inæqualiter cordatis, remote obtuse serratis, nervis secundariis angulo subrecto egredientibus, arcuatis.

White soft clay, La Grange, Tennessee.

Differs from the former by the short, unequally cordate, lanceolate pointed leaves, and by the more prominent, obtuse, and distant teeth. The secondary nerves are of about the same thickness and have the same direction, being in an open angle on the medial nerve, and somewhat abruptly curving upwards from above the middle. Near the borders they appear to fork, one branch entering the serrature, the other curving upwards to the sinus and anastomosing. The details of nervation are rendered obscure by a coat of varnish on the specimen; they are delineated, as far as they can be traced, in *a*, Fig. 7.

24. MAGNOLIA HILGARDIANA, *Lesqx.* Pl. xx, Fig. 1. Geol. Report of Arkansas, II, page 319, Pl. vi, Fig. 1. M. foliis membranaceis, oblongis, ovalibus, integris, undulatis; nervo medio angusto, nervis secundariis approximatis, camptodromis.

Red shale.

This fine leaf, of an elongated oval form, is apparently pointed or acuminate, about one foot long, with undulate borders, rounded or abruptly narrowed toward the petiole. The secondary nerves are pretty near each other; their angle of divergence, about 60°, is the same in all our fossil Magnolia of this formation. I do not know of any fossil or living species related to this.

25. MAGNOLIA LAURIFOLIA, *Spec. nov.* Pl. xx, Figs. 2 and 3. M. foliis oblanceolatis, acutis vel acuminatis, in petiolum sensim attenuatis, integerrimis; nervo medio recto, angusto, nervis secundariis numerosis, camptodromis, nervulis tenuissimis, areolis ultimis irregulariter polygonis.

Red shale.

The nervation of this species is about of the same kind as that of the former, the secondary nerves being slightly narrower and more generally opposite. But the shape of the oblanceolate, tapering downward, and quite entire leaves is far different. This form of the leaves distantly allies this species to *Terminalia Radobojensis*, Ung. No living species of ours is comparable to it.

26. MAGNOLIA LESLEYANA, *Spec. nov.* Pl. xxi, Figs. 1 and 2. M. foliis obovatis, breviter obtuse acuminatis, in petiolum longe attenuatis; nervo medio valido, transversim eroso striato; nervis secundariis distantibus, irregularibus, secundum marginem valde curvatis.

Red shale.

The long obovate leaf, narrowed into an obtuse point, and gradually decreasing toward the petiole; the broad medial and the irregular secondary nerves are the essential characters of this species. The form of the leaves resembles that of *Magnolia laurifolia;* but the nervation is different. By the irregularity and the distance of the secondary nerves, and by the shape of the leaves also, our fossil species is related to the living *Magnolia umbrella*, Lam.; though distinct enough by the more acute angle of divergence of the secondary nerves, and by the obtuse point.

27. MAGNOLIA OVALIS, *Spec. nov.* Pl. xxi, Figs. 3 and 4. M. foliis brevi petiolatis, late ovalibus, obtusis, basi rotundatis, abrupte, brevissime in petiolum decurrentibus, nervo primario lævi, nervis secundariis camptodromis, distantibus.

Red shale.

In this species the leaves are thin, broad oval, and broadly obtuse, both at the top and at the base, which abruptly descends to the short petiole. The secondary nerves are still more distant than in the former, and not quite so much curved upwards. It is altogether a species of a peculiar type, which does not appear to have any representative in our present flora,* and is not comparable to any known fossil plant.

28. MAGNOLIA CORDIFOLIA, *Spec. nov.* Pl. xxii, Figs. 1 and 2. M. foliis submembranaceis, tenuibus, late ovatis vel rotundatis, brevi acuminatis, basi cordato-truncatis, in petiolo crasso abrupte subdecurrentibus, nervo medio lato, nervis secundariis arcuatis.

Red shale.

The similarity of this species to our *Magnolia cordata*, Michx., of the Southern States, is striking. But for the thickness of the medial nerve and of the petiole, an appearance which might be explained by compression in the process of petrification, and for the broader angle of divergence of the secondary, slightly arcuate nerves, the identity of both species could not be denied. The basilar form of the leaves and their general outline are the same, for it is evident, from the direction of the margins near the broken point, that these fossil leaves are also acuminate. These are larger than generally in the living species; but all our Magnolias bear proportionally large leaves, according to climatic circumstances. The substance of the leaves appears as thin as in the former species.

29. ASIMINA LEIOCARPA, *Spec. nov.* Pl. xv, Fig. 8. A. seminibus oblongo ovalibus, uno apice truncatis, altero acutis, lævibus, pollicem longis, vix semi-latis.

---

* Prof. Gray informs me that species of Magnolia with obtuse leaves inhabit Japan; but none of them with such nearly round and large leaves as our fossil plant.

Red shale.

There is not any difference of form between this seed and those of our common Pappaw (*Asimina triloba*, Dun.). But it would be over-presuming indeed, to try to identify species from a mere flattened seed, half imbedded in the stone. In the same fruit, the seeds of the Pappaw vary greatly in form and size; they are nevertheless generally undulated or wrinkled across, a character which is not seen in the fossil.

30. PHYLLITES TRUNCATUS, *Spec. nov.* Pl. xvii, Fig. 9. P. foliis oblongis, lanceolatis, integris, undulatis, basi in petiolo brevi truncato decurrentibus; nervis secundariis gracilimis, distantibus, camptodromis.

Red shale.

The leaf is oblong, with undulate entire borders, apparently lanceolate pointed, narrowed to the petiole or to the base of the medial nerve, where it is slightly decurrent and abruptly cut, forming a short winged-like petiole. The secondary nerves are indistinct and very slender. Prof. Charles Gaudin, in his 4th Memoir of *Contributions a la flore fossile Italienne*, has published, page 23, Pl. v, Figs. 6 and 7, two leaves of the Post tertiary, which he considers as *Viburnum tinus*, S., now living in the South of France. By their form and nervation these leaves appear exactly similar to ours.

Is it possible now, from the small number of fossil plants described above, to draw any conclusion concerning their geological distribution? And first, do the plants by their analogy indicate synchronism between the various strata where they have been found?

As it is remarked in the introduction, our leaves are imbedded, either in a red, laminated, ferruginous shale, of a fine-grained compound, in whose layers the impressions of leaves are horizontally marked and distinct, though their substance is totally destroyed; or on a soft white clay, easily cut with the knife, where the impressions are equally distinct and horizontal, and the substance of the leaves also destroyed; or on a yellowish coarse sandy clay, casually veined with a soft white clay like the former. In this matter, the leaves are well defined, their substance is more or less preserved; but they are mostly distorted or folded, as if they had been transported with the materials in which they are imbedded. One of our species only is on a coarse brownish sandstone, whose compound is unlike any of the former; the substance of the leaf is fully preserved.

According to Prof. Hilgard's statements, as much as can be seen from the disposition of the plants-bearing strata, there is not any great difference in their horizontal stations. He acknowledges the lithological characters as being heterogeneous, but he accounts for this by the interposition of materials of various kinds, especially of ferruginous sand, modifying the nature of underlying clays, and by the various modes of transportation and deposition of these materials. "As for the red shales," he says, in a letter on the subject,

"I doubt very much whether they can be considered as representing by themselves a definite stage, for they occur wherever the white clays are immediately overlaid by the highly ferruginous strata of the Orange Sand." Prof. James Safford, who has studied the same group in Tennessee, writes: "That the lithological differences do not indicate any distinct formation; and that the red shales are simply local beds or layers generally of very limited extent." The question of synchronism is perhaps satisfactorily settled by these remarks. Nevertheless, as the plants have not been found at the same locality, in strata of various lithological compounds, they might, by their specific differences, indicate peculiar stages of a same geological series. Prof. Hilgard appears to have this view. For, in his general section of the Tertiary of Mississippi,* under the general division of Lignitic of Northern Mississippi, or Northern Lignitic group, underlying the Claiborne group, he places the leaves-bearing strata in the following order:

a. Gray clay and sands of Tippah, sometimes transformed into red shale. (Contains all our species of leaves marked red shale.)

b. Gray clay of Lafayette and Calhoun, with *Sabal*, &c. (Contains the species marked white soft clay.)

c. Gray clay of Winston, with *Calamopsis*. (Contains the species marked yellow coarse clay.)

The leaves on brown sandstone, *Cinnamomum*, are placed by the author with the division *b*, a connection which does not seem in accordance with what is shown by his diagram, page 116.

In considering the plants by themselves, and studying their relation of forms, we find in the red shale, twenty-two species described here from the Mississippi, and ten species formerly described,† from Somerville, Tennessee; in all thirty-two species. From the white soft clay of both States we have six species only. None of these are either identical or even analogous with those of the red shale. Indeed, taken altogether, the flora of each deposit has a peculiar facies. The first contains Oaks, Poplars, Magnolias, mostly forest species, while the other has the Willows and the Palms, rather swamp plants. Between the species of the white clay and those of the coarse yellow clay, though the number is very limited, there is on the contrary as great an analogy as between the lithological compounds of the strata. They have in common *Ceanothus Meigsii*, abundant in the white clay of Tennessee as in the yellow clay of Mississippi. One has a Palm, *Calamopsis*, the other has one also, a *Sabal*, both apparently belonging to those dwarf Palm trees which generally inhabit deep swamps. In the yellow coarse clay we find a link of connection with the flora of the red shales in *Persea lancifolia*, which is common to both.

Though the differences even in the general facies of these fossil plants may be well

* Report on the Geology and Agriculture of the State of Mississippi, page 108.

† American Journal of Science, § 2, vol. xxvii, page 363.

marked, they cannot be taken, I think, as conclusive indication of a difference in the horizontal position of the strata. At least not yet, when the materials for comparison are so scanty. Changes in the vegetation are often merely local, and caused by casual circumstances. For example, swamps along water-courses, have preserved in their clay deposits, water or shore plants, either fallen from trees grown in the same place, or transported by currents; while swamps in the forest, though contemporaneous, have in their clay deposits true forest leaves of a different character from those of the former. Moreover, the floras of the recent formations, principally of the Tertiary, have been far more local or grouped than they were in the old formations, especially during the coal epoch, whose vegetation is of the widest general uniformity. Even our red shale, though the plants which it contains have the same general facies, indicate specific differences of the same kind. For, in the specimens of Sommerville, Tennessee, and those of Tippah, Mississippi, there is only one species, *Quercus Lyellii*, common to both. It is the leaf, which from a broken specimen, and from its likeness with our now living *Laurus Caroliniensis*, I have previously considered as identical with it.*

A second question, more important still, concerns the age of the formation where our fossil leaves have been found, as indicated by the species here described. It must be admitted, at first, that the attempt to draw some positive deductions on this subject, with the small amount of materials at present collected, and without any point of comparison from our American formations, may result in unreliable conclusions. For we know nothing yet of the fossil flora of our mesozoic time; even the line of separation between the vegetation of the Tertiary and that of the Cretaceous is not traced. And if we look for comparison to what is known of the fossil plants of Europe, we find there with short memorials of Eocenic and Cretaceous floras, a splendid record of Miocenic vegetation,† where most of the types of our actual flora are represented together with species analogous to some which are recognized as belonging to the American Cretaceous. It is not surprising that a comparison made with such materials is liable to error. Yet, this is not a reason why we should lay aside our fossil plants with distrust. On the contrary, it is important to examine them carefully now and to begin by recording facts and data for future use. For, as the geological position of the group where they have been collected is well ascertained, these botanical remains, once collected in number and well studied, may furnish a point of comparison for future discoveries.

The horizon of this group, which we call, with Prof. Hilgard, *North Lignitic*, is marked first by a section by this eminent geologist, of what he considers the tertiary strata of Mississippi.

---

* American Journal of Science, § 2, vol. xxvii, page 363.

† Especially in the admirable works of Heer.

Beginning at its top, it has:*

No. 10. The Grand Gulf stage, with lignitic beds, tree palms, exogenous trees, ... 80 feet.
" 9. The Vicksburg stage, with crystalline limestone and fossil shells, ... 80 "
" 8. The ferruginous rock of Red Bluff, with fossil shells, ... 12 "
" 7. The Lignitic clay and Lignite of Vicksburg and N. Brandon, ... 20 "
" 6. The Jackson stage, with blue marls and fossils, ... 80 "
" 5. The Lignitic clay and Lignite of Jackson.
" 4. The Claiborne stage in three divisions, A. calcareous with fossils.
" 3. Lignitic clay of Clark County.
" 2. B. Silicious Claiborne, sandstone, &c., with fossils.
" 1. Northern Lignitic, where our fossil plants have been found, and whose divisions are indicated above. Thickness, ... 425 feet.

This section is most satisfactorily completed by another given by Prof. J. Safford, in a very interesting paper on the Cretaceous and Superior Formations of West Tennessee.† This section, abridged like the former, indicates from the lower strata upwards.

1st. The Coffee Sand, the inferior group of the Cretaceous in Tennessee. Under gravel and ferruginous conglomerate, it has, at its base, slaty clay and yellow sand, with fragments of fossil wood and leaves, ... 200 feet.
2d. The Green Sand group or shell bed. The author enumerates 34 species of shells from this group, which contains also, though more rarely, leaves and wood, ... 200 to 350 feet.
3d. The Ripley group, mostly made up of stratified sands. Twenty species are named from local fossiliferous beds in the upper part of the series, ... 400 to 500 feet.
4th. The Porter's group, formerly included in the following, from which it is distinct only by its proportionally more laminated or slaty beds of clay, ... 2 to 300 feet.
5th. The La Grange group, rightly considered by the author as the equivalent of Hilgard's Northern Lignitic, for it contains the same species of fossil plants in strata of exactly the same compound. This group occupies a belt 40 miles wide, along the State line of Tennessee and Mississippi, between the Tennessee and the Mississippi River. Its thickness is about. . . . . 600 feet.
6th. The Bluff lignite, apparently the equivalent of the chalk-banks of Columbus, Kentucky, which I have considered, with Dr. D. Owen, as Pliocene.
7th. The Bluff gravel, which, in Tennessee as well as at Columbus, Ky., overlies the above group. It is a ferruginous chert or coarse orange sand, mixed with shells, mostly identical with species of our time, and where also have been found the bones of *Megalonix Jeffersonii.*
8th. The Bluff loam, a soft buff-colored clay, whose animal remains are all, but one, represented by species living in the water of the Mississippi Valley.

The localities where our fossil plants have been collected, Tippah, Mississippi, La Grange and Sommerville, Tennessee, are about in the middle of the belt occupied by the

* This section is abridged. The author names the essential species of fossil shells found in connection with each division.

† American Journal of Science, § 2, vol. xxxvii, page 360.

Northern Lignitic group. As this group is underlaid by Cretaceous strata, and overlaid in Tennessee by a Pliocene formation, it seems that it should be considered as the representative of the Tertiary of that country; and if so, the plants in its middle should be of the Miocene. But in Mississippi, the Northern Lignitic appears overlaid, at least as far as stratigraphical evidence can show it, by the Vicksburg, Jackson, and Claiborne stages, which are generally referred by geologists to the Eocene series. This would place it with the Eocene or the Upper Cretaceous.

How does this conclusion agree with the indications furnished by our described fossil plants? Two at least of these leaves, one *Phyllites* and one *Rhamnus*, are referable to species now living; four more are nearly related to living species also, and none of them represent any typical or peculiar form unknown in our actual flora, any genus effaced from it; but on the contrary, the whole group has the general facies of a group of plants of our time. This is certainly not the character of an Eocenic vegetation, which, according to the too general definition of Lyell, should not contain any living species.

In Europe the Eocene deposits which have been more thoroughly studied, and have furnished to science the largest collections of fossil plants, are those of Mt. Bolca, near Verona, Italy. With a large quantity of marine and fresh-water Algæ, they have especially species of the Genera *Drepanocarpus*, *Cæsalpinia*, *Eucalyptus*, *Eugenia*, *Guajacites*, *Xanthoxylon*, *Santalum*, *Aralia*, &c., which not only have not a single representative in the Northern Lignitic, but which present a far different type of vegetation. For, as it has been remarked by Prof. Heer, the flora of Mt. Bolca, like the other Eocenic floras of Europe, bears evidence of a tropical climate. The American types are very few in it, while the East Indian and the Australian have the predominance. Nothing of this kind is shown by our fossil plants of Mississippi. They are no more tropical than the present vegetation of the Southern States, and with scarcely any exception, all the types are American. On this point of view, as from their relation to forms of living plants, the leaves of the Northern Lignitic group appear most intimately related to the Miocene of Europe. To put this assertion in full evidence, let us pursue our comparison a little further.

Heer, in his *Flora Tertiaria Helvetica*, III, page 204, fixes the divisions of the Miocene of Central Europe as follows:

V.	Upper lignitic formation,	Œningen stage,	Upper Miocene.
IV.	Marine subalpine molasse,	Helvetic stage,	Middle Miocene.
III.	2. Marine formation of Basle, 1. Gray fresh-water, molasse,	Maintz stage,	
II.	2. Marine molasse of Ralligen, 1. Lower lignitic formation,	Aquitan stage,	Lower Miocene.
I.	Marine molasse of Basle,	Tongrian stage,	

I have endeavored, as far as it was possible, to point out the relation of each of the plants of Mississippi, with species from a known geological stage. Putting the comparison in a tabular form, we have:

	Species Described.	*Nearly related to or identical with*	*Geological Stage.*
1.	Calamopsis Danai, *Lx.*	Calamopsis Bredana, *H.*	Œningen stage.
2.	Sabal Grayana, *Lx.*	Sabal major, *Un.*	Aquitan "
3.	Salisburia binervata, *Lx.*	Salisburia.	Pliocene, Europe; Cretaceous? California.
4.	Populus monodon, *Lx.*	Populus Gaudini, *Fis.*	Helvetic stage.
5.	P. mutabilis, *H.*	P. mutabilis, *H.*	Œningen "
6.	Salix Worthenii, *Lx.*	Salix tenera, *Br.*	" "
7.	S. tabellaris, *Lx.*	S. longa, *Br.*	" "
8.	Quercus Moorii, *Lx.*	Q. densiflora, *En.*	Living.
9.	Q. Lyellii, *H.*	Q. Lyellii, *H.*	Aquitan, (Bovey Tracey.)
10.	Q. retracta, *Lx.*	Q. Elœna, *Ung.*	" stage.
12.	Celtis brevifolia, *Lx.*	Celtis Mississippiensis, *Bos.*	Living.
13.	Ficus Schimperi, *Lx.*	Ficus truncata, *H.*	Œningen "
14.	F. cinnamomoides, *Lx.*	F. tiliæfolia, *Br.*	Maintz "
15.	Laurus pedatus, *Lx.*	Laurus princeps, *H.*	Œningen "
16.	Cinnamomum Mississippiense, *Lx.*	Cinn. Buchi, *H.*	Aquitan "
17.	Banksia Helvetica, *H.*	Banksia Helvetica, *H.*	Œningen "
18.	Persea lancifolia, *Lx.*	Persea speciosa, *H.*	" "
19.	Ceanothus Meigsii, *Lx.*	Ceanothus tiliæfolius, *Ung.*	Aquitan "
20.	Sapindus undulatus, *H.*	Sapindus undulatus, *H.*	Œningen "
21.	Rhamnus marginatus, *Lx.*	Rhamnus Carolinianus, *Mx.*	Living.
22.	Juglans appressa, *Lx.*	Juglans Heerii, *Ett.*	Aquitan "
23.	J. Saffordiana, *Lx.*	"	" "
24.	Magnolia Hilgardiana, *Lx.*	?	?
25.	Magnolia laurifolia, *Lx.*	Terminalia Radobojensis, *Ung.*	Aquitan "
26.	M. Lesleyana, *Lx.*	Magnolia umbrella, *Mx.*	Living.
27.	M. ovalis, *Lx.*	?	?
28.	M. cordifolia, *Lx.*	M. cordata, *Mx.*	Living.
29.	Asimina leiocarpa, *Lx.*	A. triloba, *Dun.*	"
30.	Phyllites truncatus, *Lx.*	Viburnum tinus, *L.*	"

From this table, on thirty species, without counting the fruit of Pappau, six are analogous or identical with living plants; nine with the Upper Miocene of Central Europe; two with the Middle Miocene, and eight with the Lower. Moreover, four of our plants are identical with Miocenic species of Europe. I do not think that it would be possible to find between two groups of plants, of far-distant countries, a more intimate relation than what is shown by this enumeration.

But we have, in the fossil leaves of Mississippi, a number of Magnolias, and the Euro-

pean Tertiary has none; while, per contra, the Upper Cretaceous of Europe, and also of America, have remains of this genus. Cannot then our plants belong to the Upper Cretaceous also? Do not they show any relation to those plants discovered in Nebraska by Meek and Hayden, and whose general character is so much like that of Tertiary plants, that from the descriptions given of them, they were considered by Prof. Heer and by myself as Miocenic species? Indeed, after examining the fossil plants of Nebraska, from the descriptions and figures of Capellini and Heer,* I can but admit that they have in their general facies something resembling the character of our Northern Lignitic leaves. Seventeen species are published by these authors: two *Populus*, one *Salix*, one *Betulites*, one *Ficus*, one *Platanus ?*, three *Proteoides*, one *Aristolochites*, one *Andromeda*, one *Diospiros*, one *Cissites*, two *Magnolias*, one *Liriodendron*, and one *Phyllites*, of uncertain affinity. Six of these genera are represented in the Tertiary; hence the Miocenic facies of this small group of plants. This is nevertheless evidently a family or generic likeness, very uncertain indeed; for it is not marked by any close relation or identity of forms indicating contemporaneous existence. Magnolias appear in the deposits of Nebraska as in those of Mississippi; but they are not alike, not even of the same type, and those of the Northern Lignitic have, with species of our time, an affinity which is not marked in the others. Of the species of *Salix* and *Populus*, even the generic characters are not certain; *Aristolochites* and *Cissites* present a type of leaves totally at variance with any of the Miocenic flora and of our Mississippi species, while the three species of *Proteoides* indicate a predominance of Australian types, of which we find no trace in our leaves. Still I do not consider the question as solved. It can be only satisfactorily settled by recognized difference or identity of species collected in these strata of our American formations. For it may be that as we have in our Upper Cretaceous measures, dicotyledonous plants of genera which are still represented in our actual flora, like some of the Miocene of Europe, we may have Eocenic deposits with species still more related to some of our present vegetation; thus bearing a character approaching that of the same European Miocene. Under the uniform development of the geological measures of the Mississippi Valley, the typical forms may have escaped changes from disturbing influences, similar to those which have evidently modified, by repeated cataclysms, the recent formations of Central Europe.

The examination of our Northern Lignitic leaves raises questions of remarkable interest, especially on the distribution of vegetable species, on their modifications under certain influences, on the relation of groups of plants or general floras at divers geological times, either on our continent or in comparison with other countries; on the causes of the differences, changes, &c. &c., all problems which it should be too hazardous to try to study

* Phyllites Cretacés du Nebraska par MM. les Prof. J. Capellini et O. Heer (1866).

now. The mere mention of them is sufficient to show the importance of the researches among the remains of our old floras. This fact only seems to derive from the character of the leaves of the Northern Lignitic: that our present flora has types which are peculiar to it, and which are preserved in it since formations as old as the Cretaceous, where they were already recognizable.

APPENDIX.

ON FOSSIL LEAVES FROM FORT ELLSWORTH, NEBRASKA.

THE previous paper was written, when, through the kindness of Dr. John Le Conte, I received a number of fossil plants collected near Fort Ellsworth, from the same strata where the leaves described by Messrs. Capellini and Heer had been obtained. Stratigraphy and animal palæontology have identified these formations as Upper Cretaceous. This communication is very opportune, for it enables me to bring into view for comparison the two groups of fossil plants whose character has just been discussed. And as a few of these plants are new, and others complete, by better specimens, some of the species published by Prof. Heer, this short Appendix is an interesting contribution to our American fossil botany. All the specimens are on brown coarse sandstone.

1. POPULITES MICROPHYLLUS, *Spec. nov.* Pl. xxiii, Figs. 2 and 3.

Of this species the collection has only the two broken specimens figured here. The leaf is apparently nearly round or large oval, abruptly narrowed at the base, crenate serrate on the borders, with sharp teeth pointing outward; five-nerved at base like a *Populus*, with all the nerves and veinlets so deeply marked that the surface of the leaves is wrinkled. If the basilar five nervation and the peculiar denticulation of the borders seem to refer these leaves to *Populus*, their thick coriaceous texture and their wrinkled surface cannot be compared to any known species of that genus.

2. PHYLLITES BETULÆFOLIUS, *Spec. nov.* Pl. xxiii, Fig. 4.

From the preserved part of this leaf, it appears nearly round, entire from the middle downward, coarsely serrate upwards, with large, somewhat obtuse teeth, and obtuse sinuses; the medial nerve is deep and narrow; the secondary alternate nerves of the same thickness, are at first horizontal, curving upwards near the border only, in going up to the

point of the teeth. Hence the nervation appears acrodrome. The texture of the leaves is apparently also coriaceous.

3. Persea Nebrascensis, *Spec. nov.* Pl. xxiii, Figs. 9 and 10. P. foliis coriaceis, integerrimis, lineari lanceolatis, in petiolum longum attenuatis, nervo medio crasso, nervis secundariis suboppositis, angulo acuto egredientibus, obscuris, gracilibus.

The broad medial nerve, the long thick petiole, the narrow lanceolate coriaceous leaves, give to this species a marked appearance, which I cannot compare to that of any other fossil leaf. It is distantly related to *Persea lancifolia* of the N. Lignitic, and also to species of *Eugenia* of the Eocene of Mt. Bolca.

4. Sassafras Le Conteanum, *Spec. nov.* Pl. xxxiii, Fig. 1. Quercus Benzoin? *Lesqx.*, Amer. Journ. of Science, § 2, vol. xxvii, page 360. S. foliis elongatis, ovato lanceolatis (acutis?), margine integris, undulatis; nervo medio valido, recto, nervis secundariis irregularibus, plus minusve flexuosis, sub angulo acuto egredientibus, inferioribus distantibus, secundum marginem longe curvatis.

The base of the leaf is apparently narrowed to the petiole; its form is lengthy oval, lanceolate, pointed perhaps obtusely; the inferior pair of secondary nerves is distant from the upper pair, separated from it by shorter irregular flexuous ones. This species is closely related to, if not identical with, *Quercus Benzoin*, Lesqx., of Nanaimo, Vancouver's Island. The form of the leaves is similar, the nervation is of the same type, but in the Nanaimo species the secondary nerves appear thicker, and the lower ones are exactly opposite. This last character is of no moment, I think, for in our own *Sassafras officinale* the lower secondary nerves, like the upper ones also, are as often alternate as opposite. Until better specimens prove identity or specific difference between the Nebraska and the Nanaimo species, I shall consider this last as a mere variety of *Sassafras Le Conteanum*.

5. Cinnamomum Heerii, *Lesqx.* Pl. xxxiii, Fig. 12. Amer. Journ. of Science, § 2, vol. xxvii, page 361. C. foliis ovatis, acutis vel brevi acuminatis, integris, triplinervis, nervis lateralibus margine non parallelis, usque ad $\frac{2}{3}$ ascendentibus, extus ramosis.

The incomplete diagnosis formerly given of this species, loc. cit., was from a specimen of which the lower part only is preserved. It has a short petiole, and the lateral nerves unite above the base of the leaf. In the specimen here described the lower part has been destroyed by grinding the stone to give it the form of a leaf. In both the nervation is similar. The substance of the leaves is somewhat coriaceous and the nervation well marked, though not so thick and deep as in *Cinnamomum Mississippiense*.

6. Proteoides acuta, *Heer.* Pl. xxiii, Figs. 5, 6, 7.

These fragments show the form of the whole leaf except the extreme point, which is figured by Heer, Phyll., page 17, Pl. iv, Figs. 7 and 8. The borders are undulate; the

length of the leaves at least half one foot, their texture pretty thick, without any trace of secondary nerves.

7. Proteoides Grevilliæformis, *Heer*. Pl. xxiii, Fig. 8.

The specimen shows nearly the entire leaf; its point may be somewhat obtuse or long acuminate; its form is scythe-shaped, enlarged above the base and narrowed to a short petiole. The medial nerve is well marked; the secondary ones very thin, emerging in a very acute angle, few, distant, and ascending along the borders.

8. Andromeda Parlatorii, *Heer*. Pl. xxiii, Fig. 11.

This specimen, like the former, completes one of Heer's species, of which only the middle part was known (Phyll., page 18, Pl. i, Fig. 5). The base of the leaf is decurrent on a broad short petiole, which accordingly appears slightly winged, as in *Andromeda revoluta*, Heer, of the Miocene. The nervation of both species is different.

9. Magnolia alternans, *Heer*. Phyll., page 20, Pl. iii, Figs. 2, 3, 4.

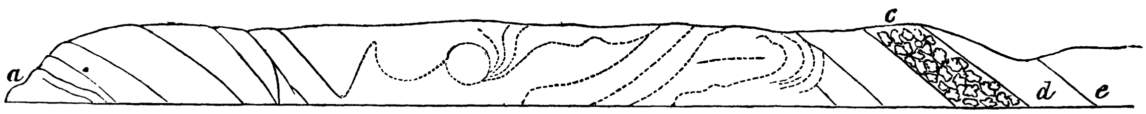
Two good specimens of this species are in the collection of Dr. Le Conte; one like Fig. 3 of Heer, the other still larger than Fig. 4. They differ from all the specimens and species from the N. Lignitic, by the strong deep secondary nervation, and by the form of the leaves also.

In the general or specific character of these cretaceous leaves there is nothing to force a modification of the remarks made on the fossil plants of the Northern Lignitic. The three first new species are without analogues in the Miocene flora, and the fourth, *Sassafras Le Conteanum*, is of a peculiar type, represented heretofore only by *Quercus Benzoin*, Lesqx., from Nanaimo, Vancouver's Island. This fact, and also the presence of *Cinnamomum Heerii*, Lesqx., in the cretaceous of Nebraska, confirms the opinion of Prof. Newberry, who, from personal examination in place, considers the Nanaimo's deposits as Cretaceous, and those of Bellingham Bay as Miocene.* As the lithological compounds which contain the fossil leaves of both localities are nearly alike, and as both formations have species of the same genera, especially of *Cinnamomum*, I supposed them synchronous, and referred them to the Miocene. For indeed *Cinnamomum Heerii*, of Nanaimo, is of a type as evidently miocenic as *Cinnamomum crassipes*, of Bellingham's Bay. This recalls to mind *Cinnamomum Mississippiense*, of the Northern Lignitic, which, as said above, is

---

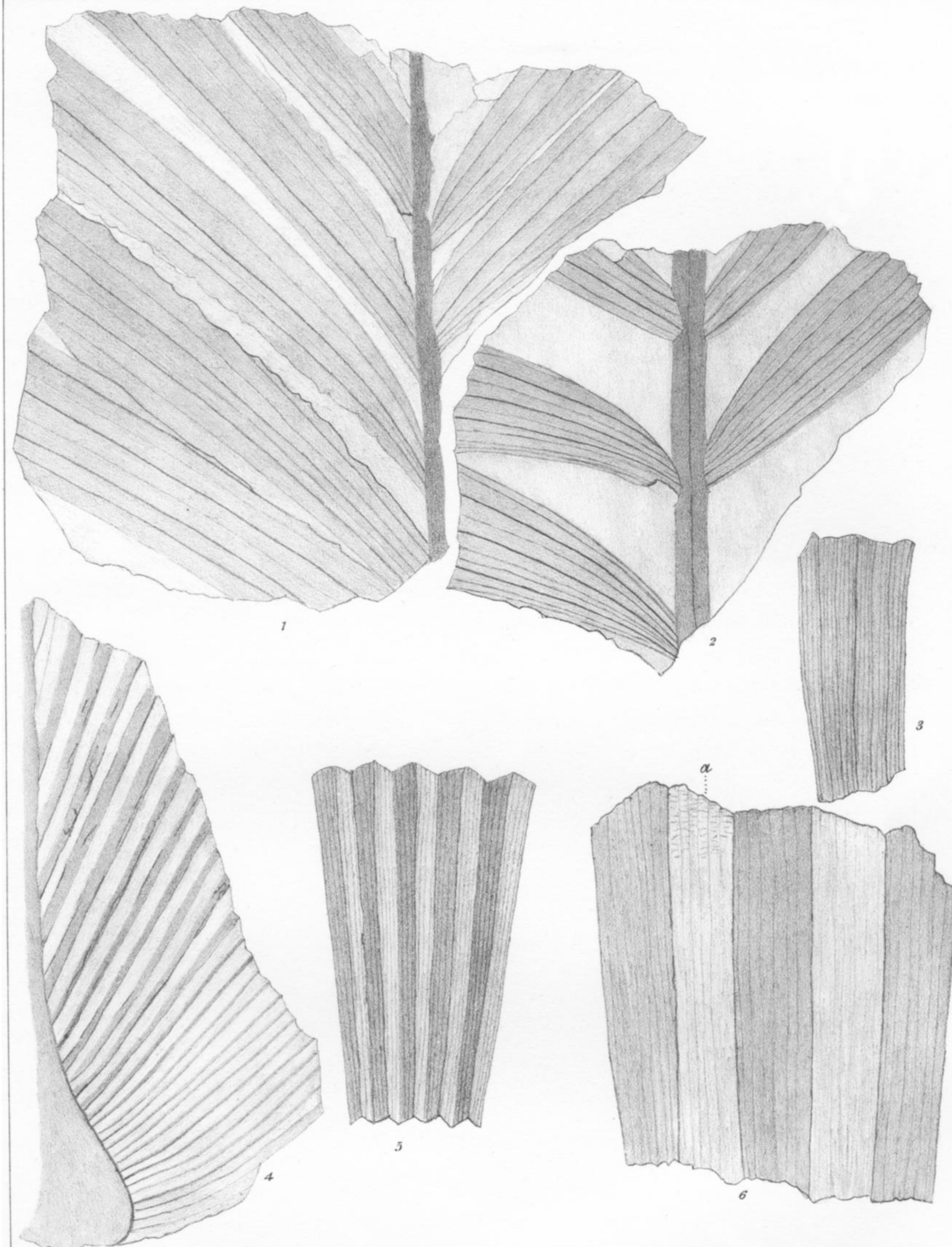
* Description of fossil plants collected by Mr. George Gibbs, by Dr. J. S. Newberry, page 3.

closely related to *C. Heerii.* I copy here the diagram of Prof. Hilgard, which comparatively shows, in *a*, the deposit where this *Cinnamomum* was found, while plants of the yellow clay, Sabal, &c.; were collected at *c*.



Section of Lignitic strata at Ragland's Branch.

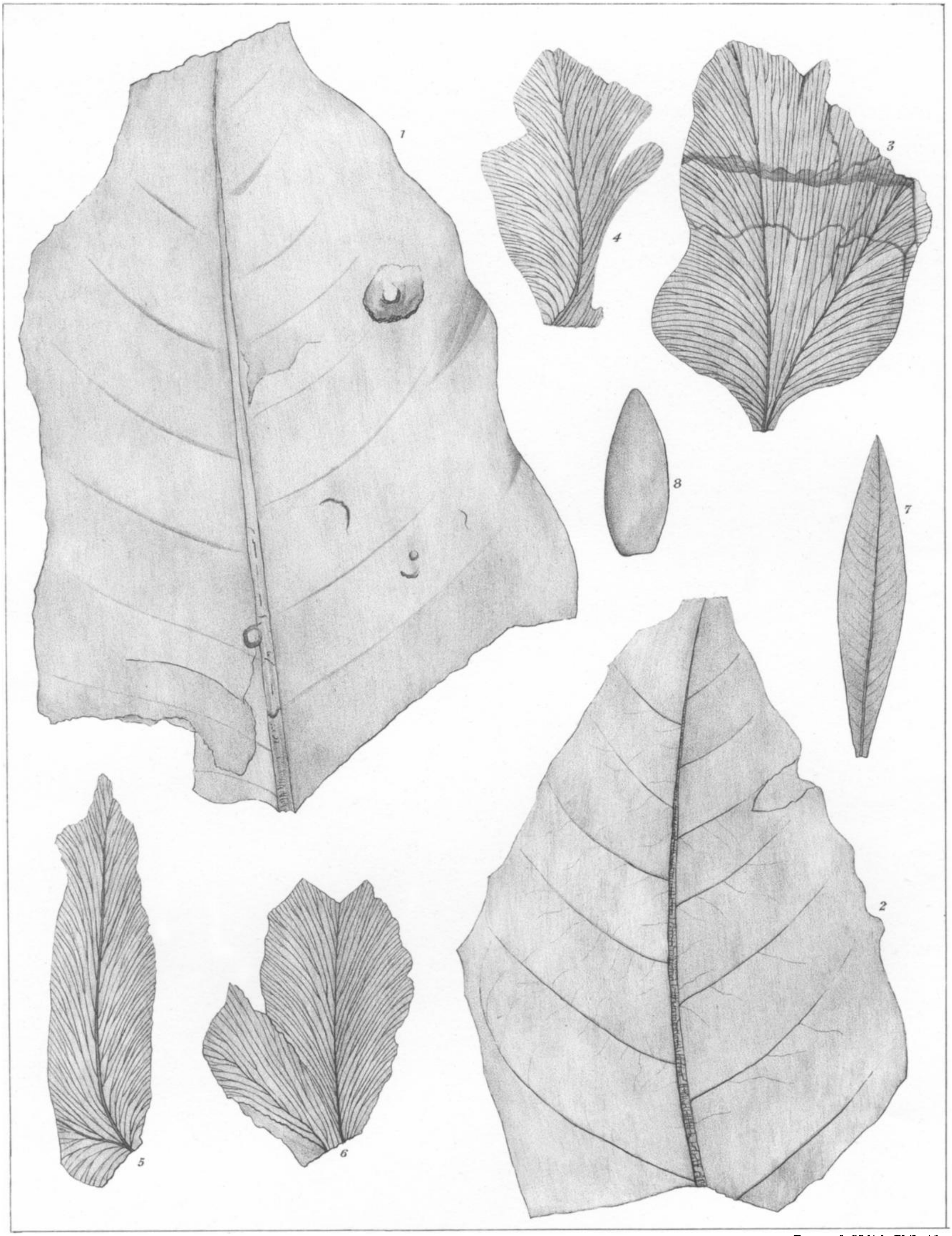
On this remarkable section the author says: "The stratum of greenish-yellow sand, *a*, contains impressions of leaves chiefly of a *Cinnamomum* not unlike *Sassafras; c* is a bed of yellowish-white clay of irregular, or thickly laminated cleavage, containing numerous leaves of Sabal, also a variety of other, chiefly dicotyledonous plants, which seem to be identical with species found in the red shale of Tippah. In the yellow sand at *d*, immediately overlying the clay stratum, there occur large billets of silicified wood, the interior of which is black. The bed of the branch of the northern half of the bluff is formed by blue clay, *e*, of massy cleavage, similar to No. 1 of sections 18 and 19, which appears to underlie horizontally. The northern dip of the strata of the outcrop seems therefore to be owing to a fault or landslide." As in section 18, mentioned above, the blue clay, *e*, underlies the red shale with plants, I would rather suppose, from this diagram, that the northern dip is due to some local uplift, and that consequently the stratum, *a*, is at a lower station than the leaves bearing clay, *c*. If it is otherwise, and if this bed, *a*, is true Northern Lignitic, we have in its fossil *Cinnamomum* the first and only direct link of connection between this formation and the Upper Cretaceous of Nebraska.



L. Lesquereux, del.

Bowen & Co. lith. Philad.a

1, 2, 3, CALAMOPSIS DANAI. 4, 5, 6, SABAL GRAYANA.

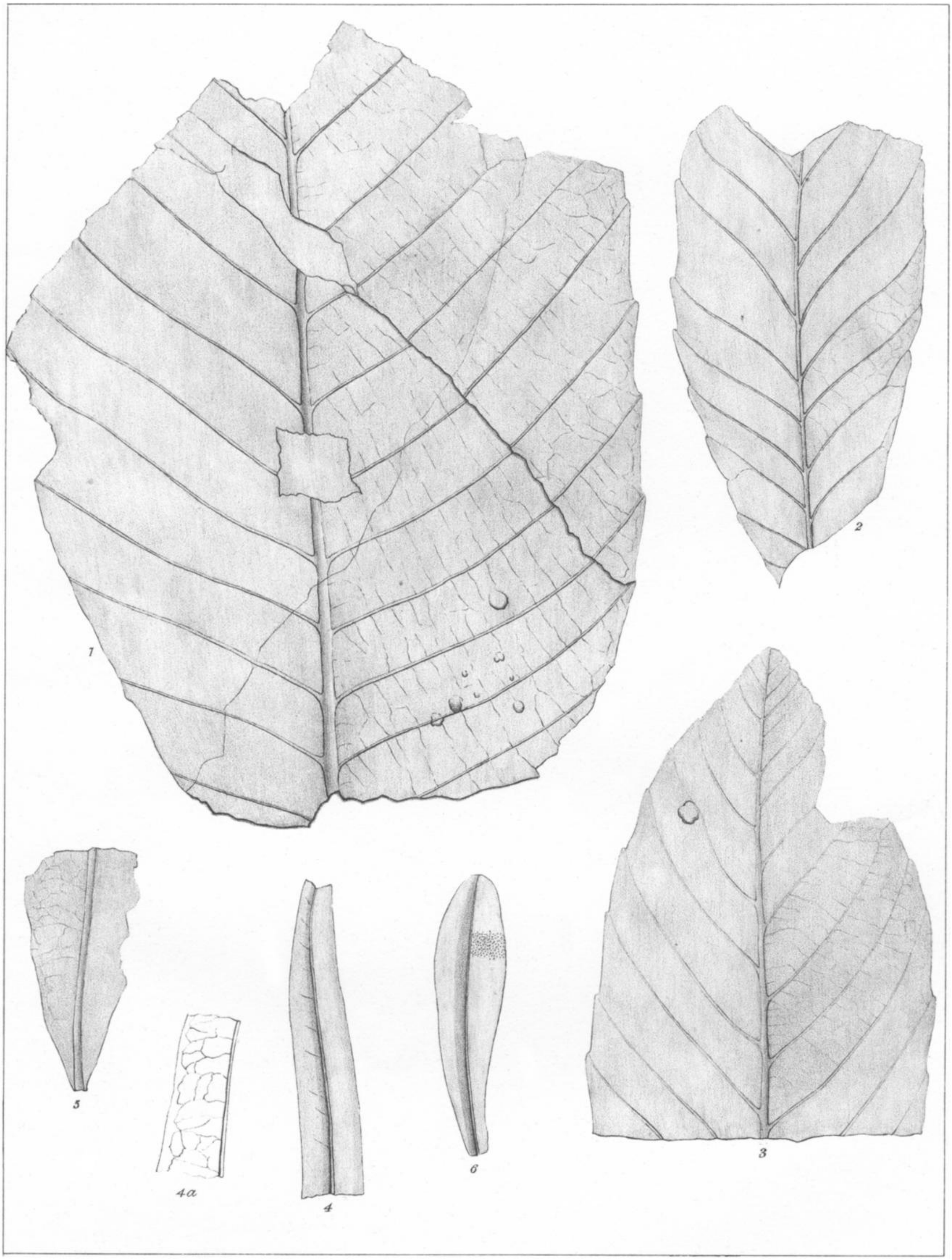


L. Lesquereux, del.

Bowen & C° lith. Philad^a

1, 2, POPULUS MONODON. 3, 4, 5, 6. SALISBURIA BINERVATA

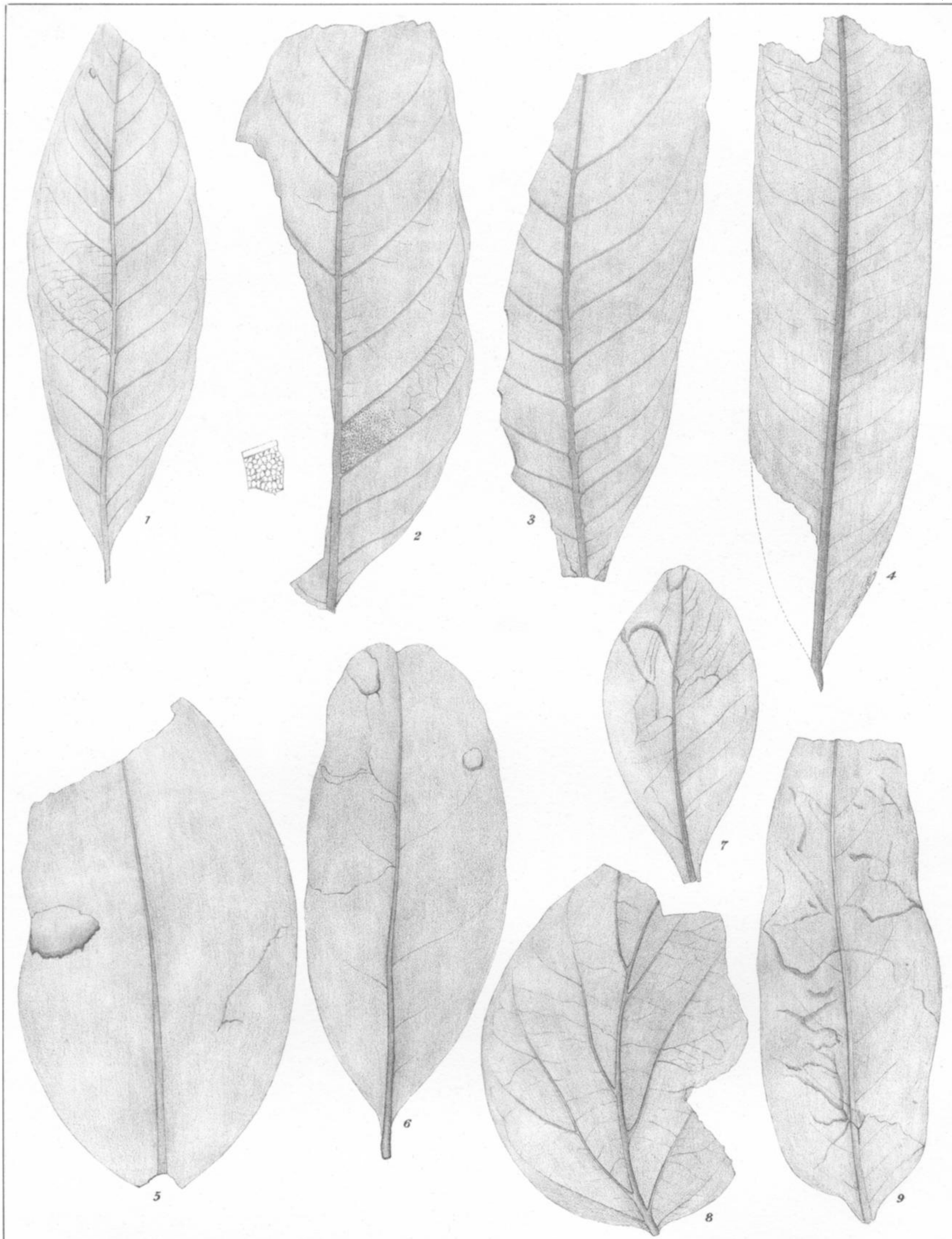
7. SALIX WORTHENII. 8. ASIMINA LEIOCARPA.



L. Lesquereux, del.

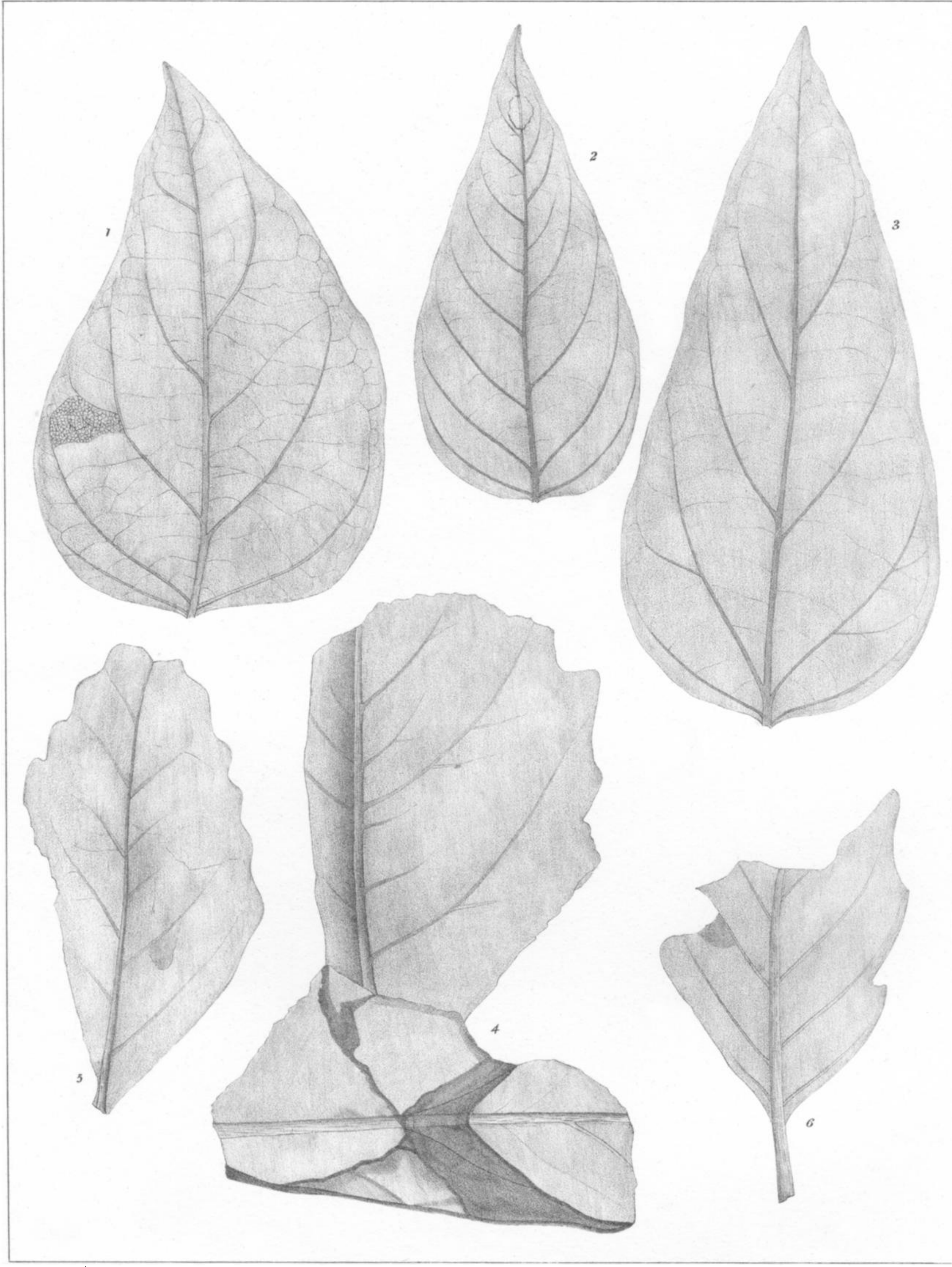
Bowen & C° lith. Philad.a

1, 2, 3. QUERCUS MOORII. 4, 5. QUERCUS RETRACTA.
6. BANKSIA HELVETICA.



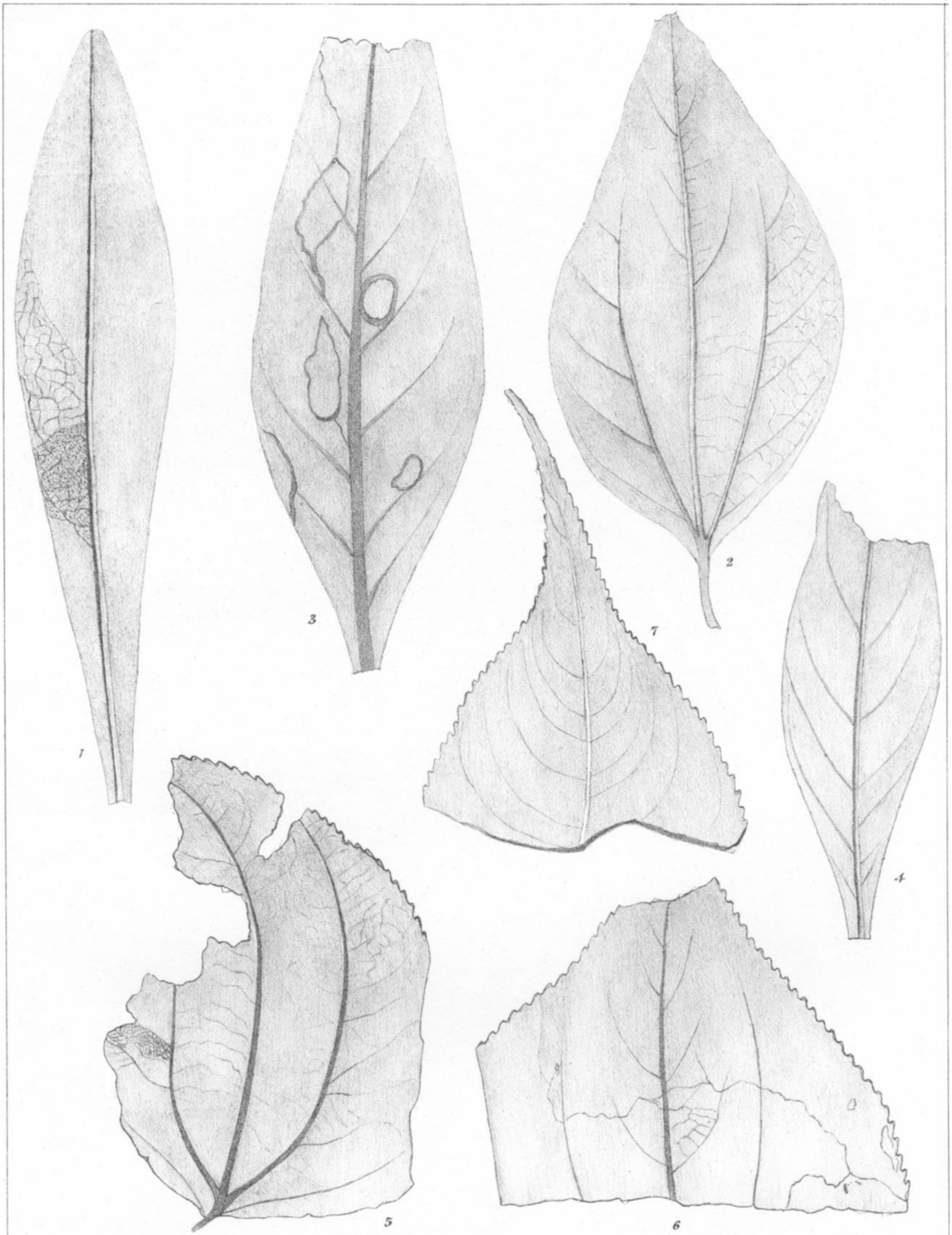
L. Lesquereux, del. Bowen & C° lith. Philad.ª

1, 2, 3. QUERCUS LYELLII. 4. SALIX TABELLARIS.
5, 6, 7. QUERCUS CHLOROPHYLLA. 8. FICUS CINNAMOMOIDES.
9. PHYLLITES TRUNCATUS.



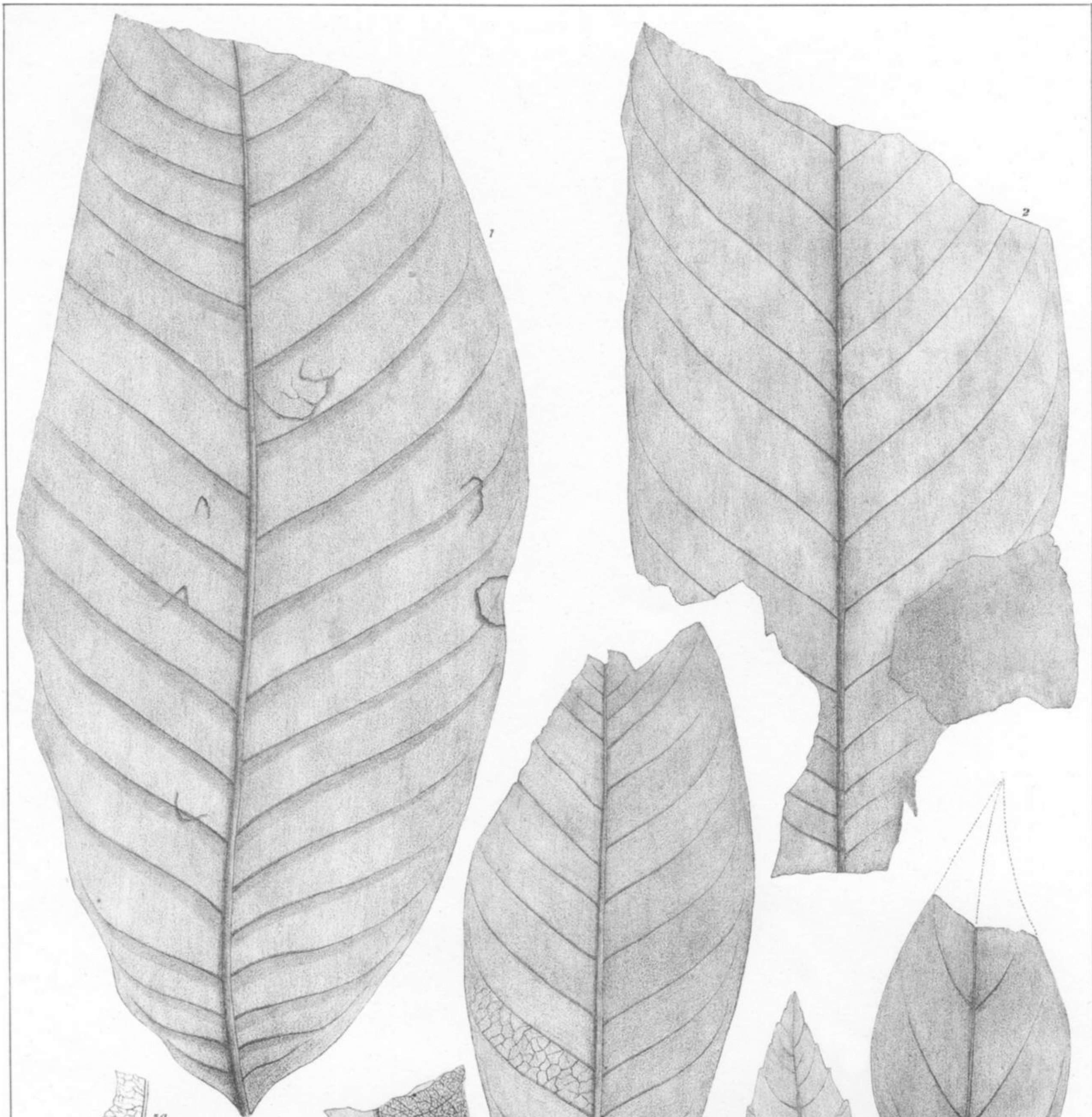
L. Lesquereux, del. Bowen & Co. lith. Philada.

1, 2, 3, FICUS SCHIMPERI. 4, 5, 6. POPULUS MUTABILIS REPANDO-CRENATA.



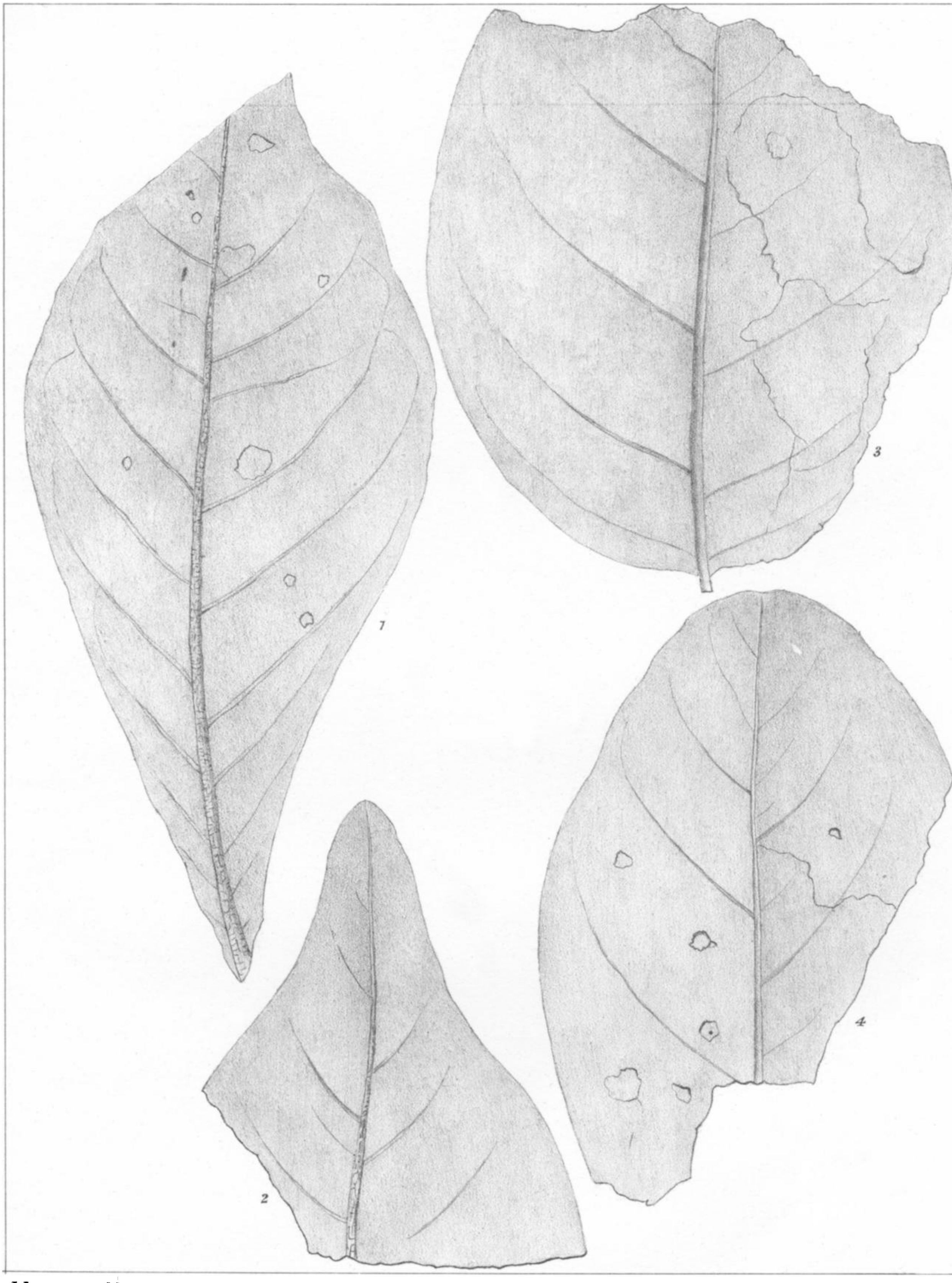
L. Lesquereux, del.   Bowen & C° lith. Philad^a

1. LAURUS PEDATUS.   2. CINNAMOMUM MISSISSIPIENSE.
3, 4 PERSEA LANCIFOLIA.   5, 6, 7. CEANOTHUS MEIGSII.



L. Lesquereux, del. Bowen & C° lith. Philad[a]

I MAGNOLIA HILGARDIANA. 2, 3, MAGNOLIA LAURIFOLIA.
4, 5. CELTIS BREVIFOLIA. 6. JUGLANS APPRESSA
7. JUGLANS SAFFORDIANA.

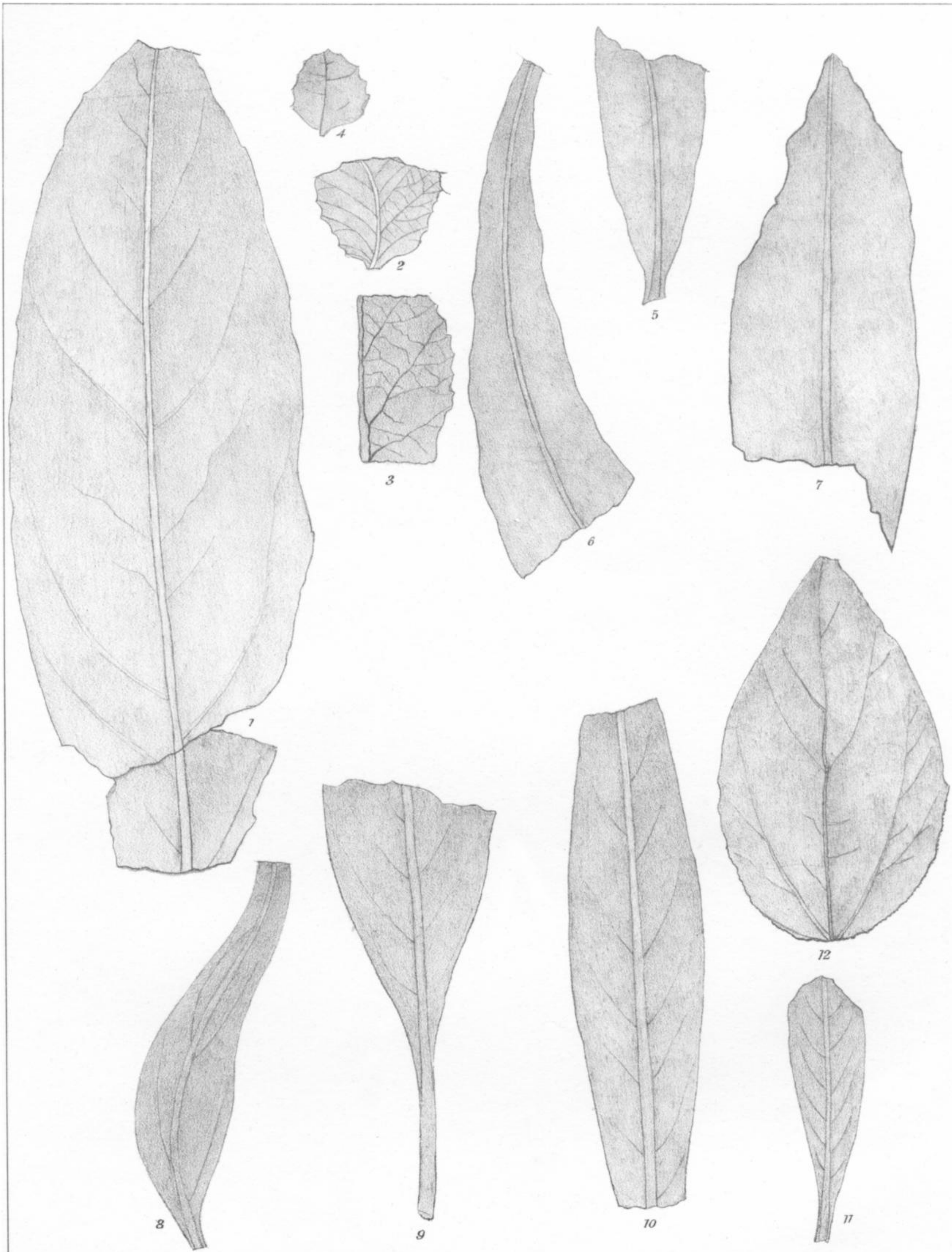


L. Lesquereux, del. Bowen & Co. lith. Philada.

1, 2, MAGNOLIA LESLEYANA. 3, 4. MAGNOLIA OVALIS.

L. Lesquereux, del. Bowen & Co. lith. Philada.

1, 2. MAGNOLIA CORDIFOLIA. 3, 4, 5, RHAMNUS MARGINATUS
6. SAPINDUS UNDULATUS.



L. Lesquereux, del.

Bowen & C° lith. Philad^a

1. SASSAFRAS LECONTEANUM.
2,3, POPULITES MICROPHYLLUS.
4 PHYLLITES BETULÆFOLIUS.
5,6,7 PROTEOIDES ACUTA.
8. PROTEOIDES GREVILLIÆFORMIS.
9,10. PERSEA NEBRASCENSIS.
11. ANDROMEDA PARLATORII.
12. CINNAMOMUM HEERII.